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(54) Electronic woman thermometer

(57) An electronic woman thermometer includes a body temperature measuring circuit for measuring the body temperature, a first memory block for storing the body temperature of the present day and the predetermined number of preceding days, and a second memory block for storing the menstruation cycle data. A determination circuit is responsive to the data stored in the first memory block and the second memory block for determining whether the present day belongs to the conceiving period or the sterile period. The determination result is displayed on a display panel.

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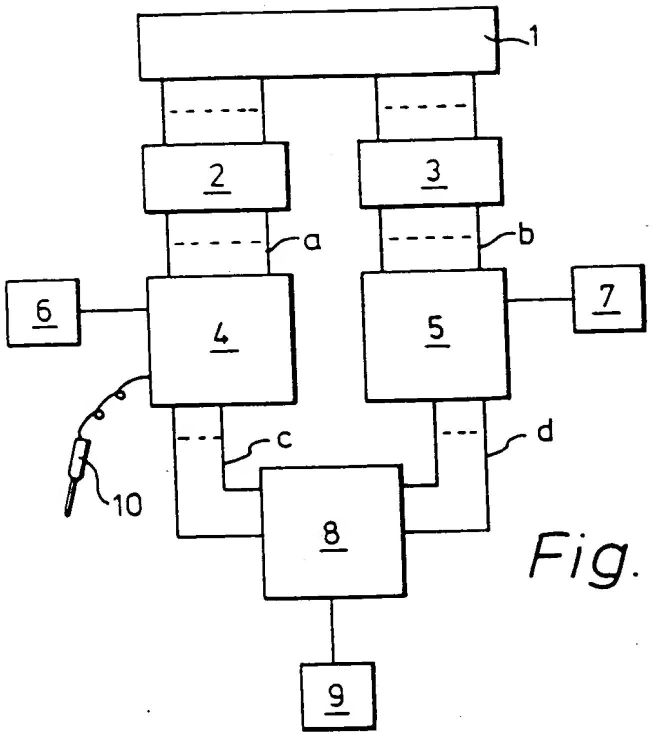

Fig.1.

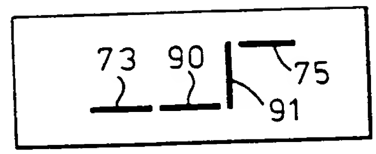

Fig.6.

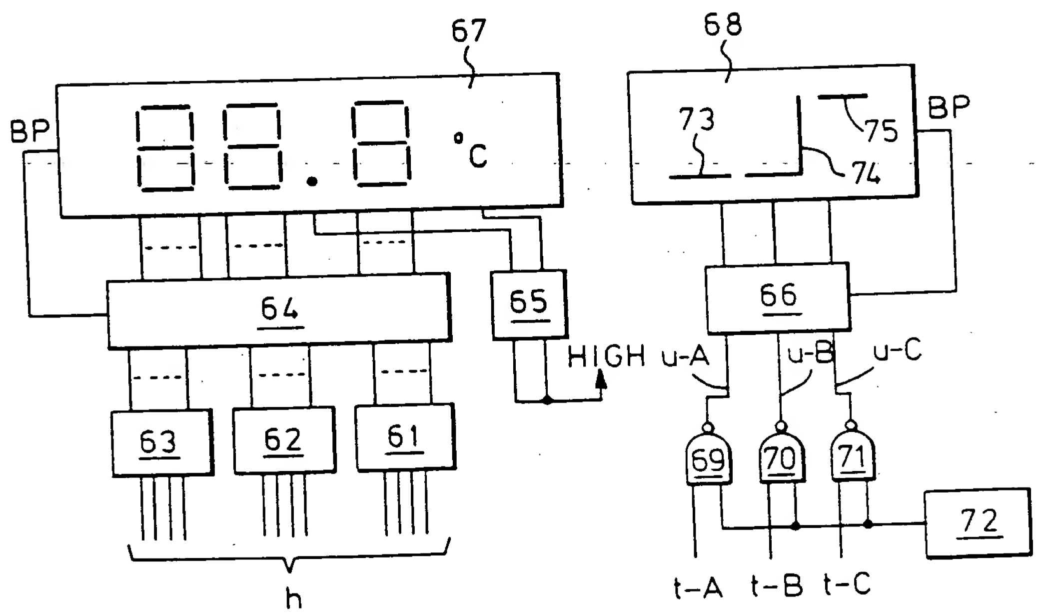

Fig.4.

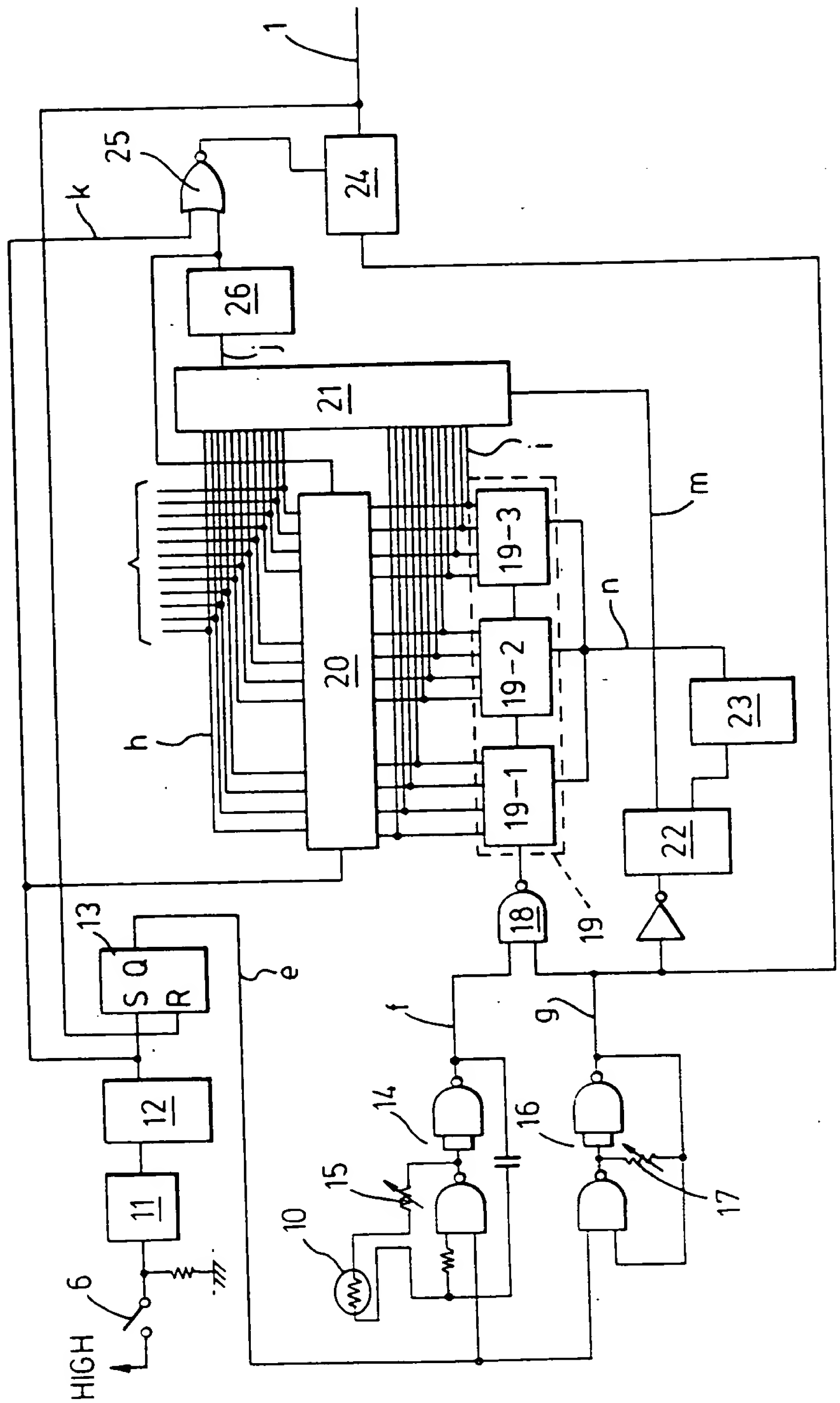
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Fig.2.

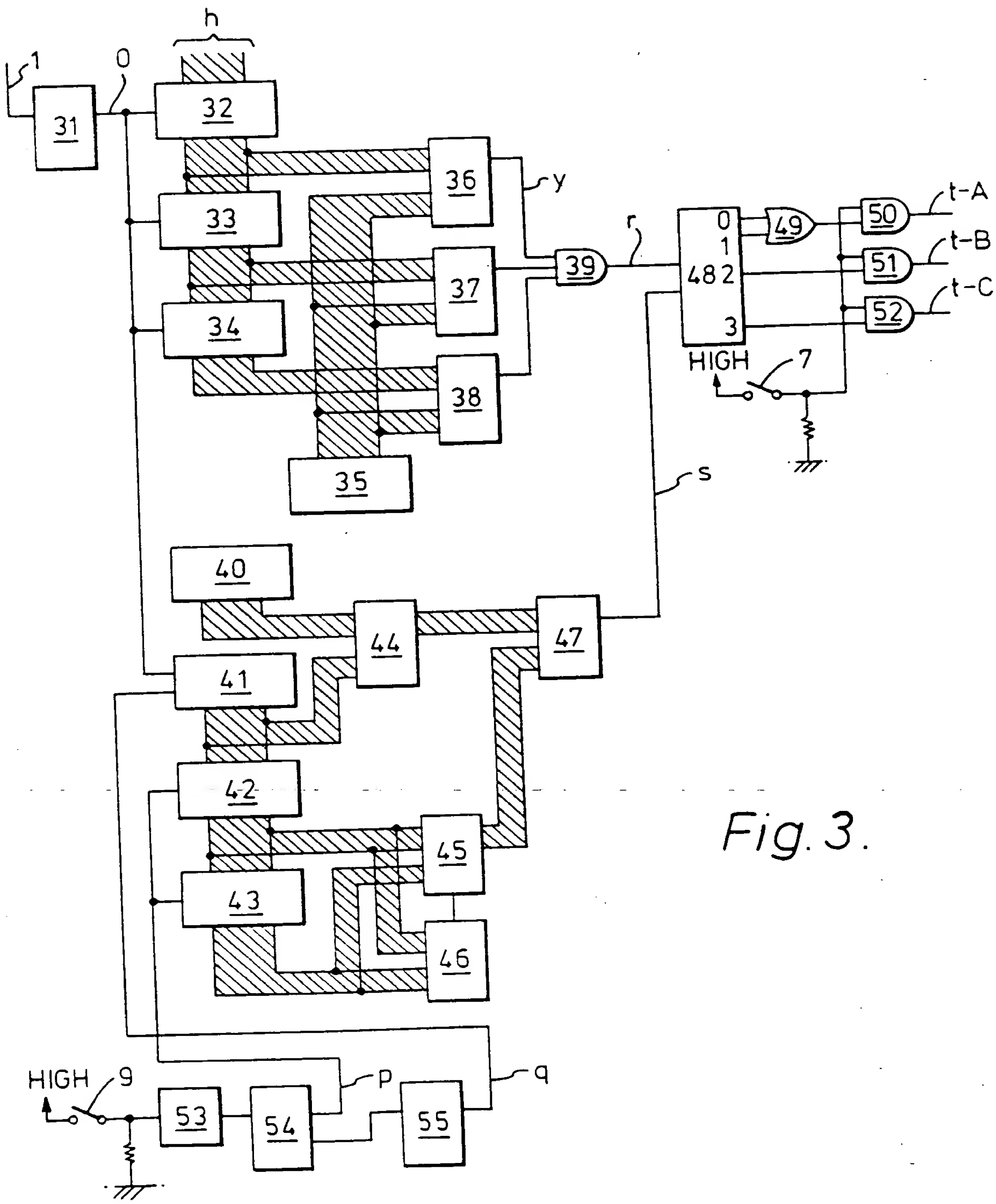
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Fig. 3.

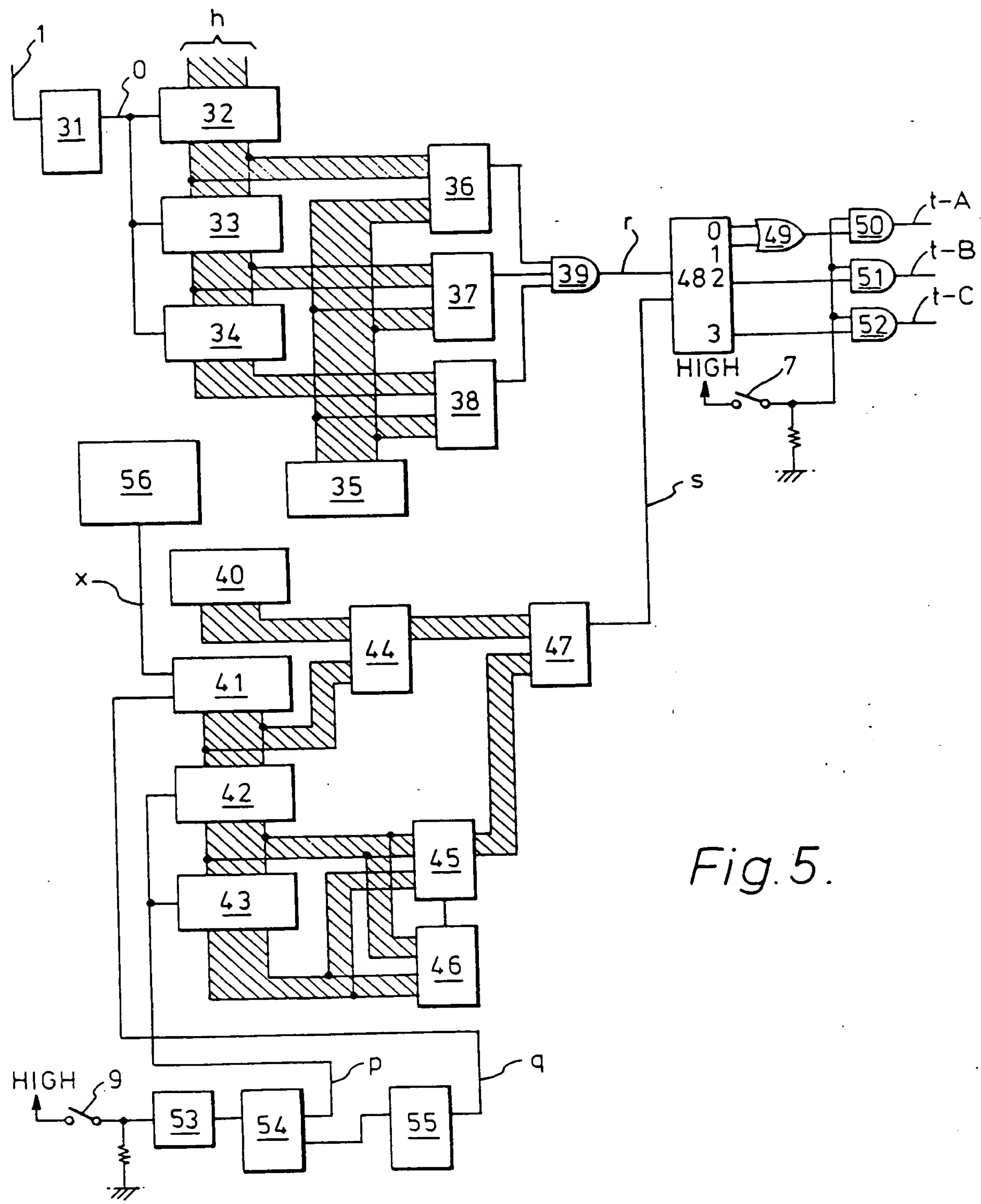
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Fig. 5.

SPECIFICATION

Electronic woman thermometer

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to an electronic woman thermometer and, more particularly, to an electronic thermometer for indicating a conceiving period or a sterile period by combining basal body temperature information and menstruation cycle information.

The Mr. Ogino method and the basal body temperature (BBT) method are well known for the birth control. The Mr. Ogino method is based on the fact that the conceiving period is eight days commencing on a day nineteen (19) day before the next coming menstruation and ending on a day twelve (12) day before the next coming menstuation without regard to the menstruation cycle period. The basal body temperature (BBT) method is based on the fact that the basal body temperature normally shows the bisphasic curve including the postmenstrual low temperature phase and the premenstrual high temperature phase.

It is most effective to combine the above-mentioned two methods to ensure the birth control.

Accordingly, an object of the present invention is to provide an electronic woman thermometer which includes a control circuit for effectively combining the basal body temperature information and the menstruation cycle information.

In a preferred form, an indication system is provided for indicating te conceiving period of the sterile period in accordance with the detected basal body temperature information and the calculated menstruation cycle information stored in the electronic thermometer.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention and wherein:

Figure 1 is a block diagram of an embodiment of an electronic thermometer of the present invention;

Figure 2 is a circuit diagram of a body temperature detection circuit included in the electronic thermometer of Fig. 1;

Figure 3 is a detailed block diagram of an embodiment of a determination circuit and a storage circuit included in the electronic thermometer of Fig. 1;

Figure 4 is a circuit diagram of an embodiment of a display system included in the electronic thermometer of Fig. 1;

Figure 5 is a detailed block diagram of another embodiment of the determination circuit and the storage circuit included in the electronic thermometer of Fig. 1; and

Figure 6 is a plan view showing a display condition in another embodiment of the display system included in the electronic thermometer of Fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 schematically shows an embodiment of an electronic thermometer of the present invention.

The electronic thermometer mainly comprises a liquid crystal digital display unit 1, a body temperature detection circuit 4, a determination circuit 5, and a storage circuit 8. For detecting the basal body temperature, a sensor probe 10 is inserted into the mouth, and a temperature detection initiation command key 6 is actuated. The oral temperature detected by the sensor probe 10 and the associated body temperature detection circuit 4 is displayed on the display unit 1 through a display driver 2. The oral temperature information is also applied to the storage circuit 8 via a signal line c. The storage circuit 8 is associated with a menstruation first day input key 9 for storing information related to the initiation day of the menstruation. After completion of the basal body temperature detection, a determination request key 7 is actuated to activate the determination circuit 5 which introduces the temperature information and menstruation data from the storage circuit 8 through a signal line d to determine as to where does the present day belong in the cycle of menstruation. The determination result is displayed on the display unit 1 through another display driver 3.

The measured body temperature is displayed through the use of a maximum value holding method which will be described later. The temperature measuring operation is automatically terminated when the maximum value does not change for a predetermined period of time. No value is added to the measured temperature after completion of the measuring operation. The temperature detection initiation command key 6 can be omitted when the system is constructed so that the temperature detection is automatically started when the sensor probe 10 is drawn out from a sheath, or when the system is constructed so that the temperature detection operation is automatically started when the sensor probe 10 contacts a member of which the temperature is higher than a preselected level, for example, 35°C.

Fig. 2 shows the body temperature detection circuit 4 in detail. The body temperature detection circuit 4 mainly comprises astable multivibrators 14 and 16, a three-digit BCD counter 19, a twelve-bit latch circuit 20, a comparator 21, and a counter 24.

When the temperature detection initiation command key 6 is actuated, a key output signal is applied to a one-shot multivibrator 12 through a chatter free circuit 11 to set a flip-flop 13. An output signal k of the one-shot multivibrator 12 is also applied to a NOR gate 25, of which an output signal is applied to the counter 24 to reset it. When the flip-flop 13 is set, the flip-flop 13 develops an output signal e to activate the astable multivibrators 14 and 16. The oscillation frequency of the astable multivibrator 14 is dependent on the body temperature detected by the sensor probe 10.

The astable multivibrator 16 is constructed to develop an output signal g of which the frequency is about 1/400 of the output frequency of the astable multivibrator 14. When the output signal g bears the logic value "1", an output signal f of the astable multivibrator 14 is applied to the three-digit BCD counter 19 through an NAND gate 18. When the output signal g of the astable multivibrator 16 bears the logic value "0", the count operation conducted by the three-digit BCD counter 19 is interrupted, and a one-shot multivibrator 22 is turned set.

The contents counted in the three-digit BCD counter 19 represent the detected body temperature. More specifically, a portion 19–1 represents the temperature information in the order of 10^{-2}, a portion 19–2 represents the temperature information in the order of 10^{-1}, a portion 19–2 represents the temperature information in the order of 10^{0}, and a portion 19–3 represents the temperature information in the order of 10^{1}. Variable resistors 15 and 17 are provided for adjustment purposes. When the one-shot multivibrator 22 is set, an output signal m is applied to the comparator 21 to activate it. The comparator 21 functions to compare an output data i derived from the three-digit BCD counter 19 with an output data h derived from the twelve-bit latch circuit 20. When the output data i is greater than the output data h, a detection output j (indicating $i > h$) is developed from the comparator 21 and applied to a one-shot multivibrator 26. Upon receiving the detection output j, the one-shot multivibrator 26 is turned set, and an output signal of the one-shot multivibrator 26 is applied to the latch circuit 20 to introduce the data stored in the BDC counter 19 into the latch circuit 20. In this way, the latch circuit 20 holds the maximum value of the detected body temperature. The output signal of the one-short multivibrator 26 is also applied to the counter 24 through the NOR gate 25 for clearing the counter 24.

Another one-shot multivibrator 23 is set at the trailing edge of the output signal of the one-shot multivibrator 22, and an output signal n of the one-shot multivibrator 23 is applied to the BCD counter 19 to clear it. In this way, the comparing operation is conducted by the comparator 21 at every trailing edge of the output signal of the astable multivibrator 16. When the output data h derived from the latch circuit 20 is greater than or equal to the output data i derived from the BDC counter 19, the contents stored in the counter 24 are increased by one. When the contents stored in the counter 24 exceed a preselected value, an overflow signal l is developed from the counter 24, which indicates the completion of the temperature measuring operation. The thus developed overflow signal l is applied to the flip-flop 13 to reset it, whereby the oscillation of the estable multivibrators 14 and 16 are terminated.

The output data h derived from the twelve-bit latch circuit 20 is applied to the above-mentioned display driver 2 and the storage circuit 8. And, the overflow signal l is applied to the storage circuit 8. The body temperature detection circuit 4 of Fig. 2 can be easily modified to measure the body temperature to the order of 0.05°C.

Fig. 3 shows the determination circuit 5 and the storage circuit 8 in detail. The storage circuit 8 mainly comprises a one-shot multivibrator 31, twelve-bit latch circuits 32, 33 and 34, a two-digit BCD counter 41, a one-shot multivibrator 54, and eight-bit latch circuits 42 and 43. The determination circuit 5 mainly comprises comparators 36, 37, 38, 46 and 47, and a two-bit decocer 48.

The above-mentioned overflow signal l is applied to the one-shot multivibrator 31 to set it. An output signal o derived from the one-shot multivibrator 31 is applied, as a latch timing signal, to the twelve-bit latch circuits 32, 33 and 34, whereby the contents stored in the first latch circuit 32 are shifted to the second latch circuit 33, and the contents stored in the second latch circuit 33 are shifted to the third latch circuit 34. And, at the same timing, the output data h derived from the body temperature detection circuit 4 and representing the now detected body temperature is introduced into the first latch circuit 32. In this way, the three-day body temperature data is memorized.

The two-digit BCD counter 41 receives the output signal o as a clock signal to memorize what number is the present day counted from the first day of the last menstruation. When the menstruation first day input key 9 is actuated, the key output signal is applied to the one-shot multivibrator 54 via a chatter free circuit 53 for setting the one-shot multivibrator 54. When the one-shot multivibrator 54 is set, the on-shot multivibrator 54 develops a latch signal p which is applied to the eight-bit latch circuits 42 and 43. In response to the latch signal p, the contents

stored in the BCD counter 41 are transferred to the latch circuit 42, and the contents stored in the latch circuit 42 are transferred to the latch circuit 43. Accordingly, the latch circuit 42 stores the cycle period of the last menstruation, and the latch circuit 43 stores the cycle period of the next last menstruation.

At the trailing edge of the output signal p of the one-shot multivibrator 54, another one-shot multivibrator 55 is turned set. An output signal q of the one-shot multivibrator 55 is applied to the two-digit BCD counter 41 for clearing it.

When the determination request key 7 is actuated, the determination result is displayed on the display unit 1 as long as the determination request key 7 is actuated. The contents stored in the BCD counter 41 and contents stored in a constant number storage 40, which stores a constant number "19", are added by an adder 44, and the addition result is applied to the comparator 47. The contents stored in the latch circuits 42 and 43 are compared by the comparator 46, and the comparison result is applied to a multiplexer 45 as a selection instruction signal. The multiplexer 45 functions to pass the smaller contents stored in the latch circuits 42 and 43. An output data derived from the multiplexer 45 is applied to the other input terminal of the comparator 47. An output signal s of the comparator 47 bears the logic value "0" when the output data derived from the adder 44 is smaller than the output data derived from the multiplexer 45, and bears the logic value "1" when the output data derived from the adder 44 is greater than or equal to the output data derived from the multiplexer 45. That is, the logic value "0" represents the fact that the present day belongs to the sterile period in the postmenstrual phase, and the logic value "1" represents the fact that the present day belongs to the conceiving period or the sterile period in the premenstrual phase.

Another constant number storage 35 stores a BCD code "366" which represents 36.6°C which is generally considered as a boundary value of the low phase and the high phase. The contents stored in the latch circuits 32, 33 and 34 are compared with the constant number stored in the constant number storage 35 at the comparators 36, 37 and 38, respectively. If the all three data stored in the latch circuits 32, 33 and 34 are higher than the boundary value, an AND gate 39 develops an output signal r of the logic "1". The output signal r bears the logic value "0" when at least any one data stored in the latch circuits 32, 33 and 34 is lower than or equal to the boundary value.

The thus obtained output signal r and the above-mentioned output signal s derived from the comparator 47 are applied to the two-bit decoder 48. The output signal r is derived from the basal body temperature information, and the output signal s is derived from the menstruation cycle information. The combination of the output signals r and s represents the following matters and decoded to a code signal.

TABLE I (TWO-BIT DECODER -48-)

s	r	code (output signal)	meanings
0	0	0	low phase before the conceiving period
0	1	1	high phase before the conceiving period
1	0	2	low phase in and after the conceiving period
1	1	3	high phase in and after the conceiving period

The output code signals "0" and "1" derived from the two-bit decoder 48 are applied to an AND gate 50 through an OR gate 49. An output signal t-A of the AND gate 50 represents the sterile period before the conceiving period. The output code signal "2" is applied to an AND gate 51, of which an output signal t-B represents the conceiving period. The output code signal "3" is applied to an AND gate 52, of which an output signal t-C represents the sterile period after the conceiving period. These output signals t-A, t-B and t-C are applied to the display driver 3. The code signal "1" is generally considered as an abnormal condition and, therefore, the code signal "1" is applied to the OR gate 49 to be included in the sterile period represented by the code signal "0".

Fig. 4 shows an example of the display drivers 2 and 3. The display driver 2 mainly comprises seven-segment decoders 61, 62 and 63, a driver circuit 64, and a liquid crystal display unit 67. The display driver 3 mainly comprises a pulse generator 72, a driver circuit 66, and a liquid crystal display unit 68.

The seven-segment decoder 61 takes charge of the data in the order of 0.1°C, the seven-segment decoder 62 takes charge of the data in the order of 1°C, and the seven-segment decoder 63 takes charge of the data in the order of 10°C. That is, the basal body temperature data h derived from the body temperature detection circuit 4 is introduced into the decoders 61, 62 and 63. Output signals of the decoders 61, 62 and 63 are applied to the driver circuit 64 to

display the measured body temperature on the liquid crystal display unit 67 in a digital fashion. Another driver circuit 65 is provided for continuously activating the decimal point indicator and the centigrade symbol.

The above-mentioned determination output signals t–A, t–B and t–C are applied from the determination circuit 5 to NAND gates 69, 70 and 71, respectively. The pulse generator 72 develops an output signal of 1 Hz, duty 50%, which is applied to the NAND gates 69, 70 and 71. When, for example, only the determination output signal t–A bears the logic value "1", and the remaining signals t–B and t–C bear the logic value "0", an output signal u–A derived from the NAND gate 69 shows the pulse configuration, and output signals u–B and u–C derived from the NAND gates 70 and 71 continuously bear the logic value "1".

The liquid crystal display unit 68 comprises three segments 73, 74 and 75 which are aligned in a fashion corresponding to a typical basal body temperature curve. More specifically, the segment 73 functions to indicate the low phase before the conceiving period, the segment 74 functions to indicate the low phase in the conceiving period and the first two days in the high phase, and the segment 75 functions to indicate the high phase. Accordingly, when only the output signal t–A bears the logic value "1", the segment 73 is drive to flicker and the remaining segments 74 and 75 are continuously activated. When the segment 73 or 75 is driven to flicker, the object woman is in the sterile period. Other types of display system can be employed to selectively indicate the conceiving period and the sterile period.

The followings are improvements over the above-mentioned embodiment of the present invention.

(1) In the above-mentioned embodiments, the two-digit BCD counter 41 receives the clock signal o, which is developed upon every completion of the body temperature measuring operation, for storing the data information. Accordingly, the temperature measuring operation must be performed every morning to ensure an accurate operation or determination of the system. To avoid the above-mentioned defects, in another preferred form of the present invention, a time keeping circuit is provided for storing the data information.

Fig. 5 shows another embodiment of the determination circuit 5 and the storage circuit 8. Like elements corresponding to those of Fig. 3 are indicated by like numerals.

A time keeping circuit 56 is provided to keep the current time information. The time keeping circuit 56 develops a one day timing signal x at a predetermined time in a day, for example, at 0:00 a.m. Of course, it is preferable that an adjusting key is associated with the time keeping circuit 56 to compensate for the deviation. The thus developed one day timing signal x is applied to the two-digit BCD counter 41 for storing the data information.

(2) In the above-mentioned embodiment, the body temperature display operation is started when the temperature detection initiation command key 6 is actuated. When a comparator is positioned in the output line of the twelve-bit latch circuit 20 in Fig. 2 for passing the output data from the latch circuit 20 to the display driver 2 only when the output data belongs to a range between 35°C (minimum) and 42°C (maximum), an abnormal data will not be displayed on the liquid crystal display unit 67.

(3) In the above-mentioned embodiment, the measured basal body temperature is continuously displayed on the liquid crystal display unit 67 until the measuring operation is again conducted next day. It is more preferable to employ two power supply circuits, one being assigned to supply power to the display system for a predetermined period of time after completion of the measuring operation, thereby preventing the display segments from being deteriorated. The other power supply circuit is provided for continuously supplying power to the latch circuits 32, 33, 34, 42 and 43 and the counter 41 for storing the data contained therein.

(4) In the above-mentioned embodiment, the basal body temperature is held in the system for two days. However, the temperature data can be stored in the system for a longer period, if required.

(5) In the above-mentioned embodiment, the boundary value between the high phase and the low phase is fixed at 36.6°C. To ensure a more accurate determination it is preferable to include a circuit for calculating the boundary value by utilizing the measured basal body temperature. To achieve this feature, a memory system is provided for storing basal body temperature data for many days. More specifically, the basal body temperature data of plural days are added in the calculation circuit and the total value is divided by the sample number to obtain the mean value, which is used for the boundary value.

(6) In the above-mentioned embodiment, the menstruation cycle is determined through the use of the last two cycle period. The sample data for obtaining the menstruation cycle should be increased to enhance the reliability. More specifically, the storage circuit 8 includes a desired number of latch circuits similar to the latch circuits 42 and 43. And, the comparator 46 and the multiplexer 45 should be substituted by the minimum value selection circuit. The thus obtained minimum value of the menstruation cycle is applied to the comparator 47. In the present system the maximum value of the menstruation cycle is not required, because the last day of the conceiving period is determined through the use of the measured basal body temperature.

(7) The liquid crystal display unit 68 is not necessarily limited to the segment configuration shown in Fig. 4. Fig. 6 shows another example of the liquid crystal display unit 68. In this example, the segment 74, which indicates the conceiving period, is divided into two segments 90 and 91, the segment 90 being assigned to indicate the conceiving period in the low phase, and the segment 91 being assigned to indicate the conceiving period in the high phase. To achieve the segmented display of Fig. 6, the driver circuit 66 in Fig. 4 must be modified to the four-bit construction. Moreover, the determination circuit 5 shown in Fig. 3 should be modified as follows. An output signal y derived from the comparator 36 is independently introduced into the decoder, whereby the determination signal t–B is divided into two different signals.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications are intended to be included within the scope of the following claims.

CLAIMS

1. An electronic woman thermometer/calculator comprising:

first memory means for storing a basal body temperature data of the present day;

second memory means for storing the basal body temperature data of a predetermined plurality of preceding days;

counter means for accumulating a date number within the present cycle of menstruction;

third memory means for storing the cycle period information of a predetermined plurality of preceding menstruation cycles;

determination means for introducing output signals derived from said first memory means, second memory means, counter means and third memory means and developing a determination result indicating whether the present day belongs to the conceiving period or the sterile period; and

indication means for indicating the conceiving period or the sterile period in response to said determination result derived from said determination means.

2. The electronic woman thermometer/calculator of claim 1, further comprising:

a sensor probe for measuring the basal body temperature;

a basel body temperature measuring circuit for developing the basal body temperature data in response to an output signal derived from said sensor probe; and

digital display means for displaying basal body temperature data stored in said first memory means.

3. The electronic woman thermometer/calculator of claim 2, wherein said digital display means comprises a three-digit liquid crystal display unit.

4. The electronic woman thermometer/calculator of claim 1, 2 or 3, wherein said indication means comprises:

a display unit having at least three segments aligned in a typical basal body temperature curve, wherein

a first segment is assigned to indicate the low phase before the conceiving period;

a second segment is assigned to indicate the conceiving period; and

a third segment is assigned to indicate the high phase after the conceiving period.

5. The electronic woman thermometer/calculator of claim 4, wherein one of said segments is drive to flicker in response to the determination result developed from the determination means.

6. An electronic thermometer substantially as herein described with reference to Figs. 1 to 4, optionally as modified by Fig. 5 and/or Fig. 6, of the accompanying drawings.

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